

Broadening Participation in the Ocean Sciences:

A COSEE Network Priority



Credit: COSEE Southeast

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Introduction

Broadening opportunities for participation of all citizens — in terms of gender, race/ethnicity, persons with disabilities, and socioeconomic status — is essential to the health and vitality of the national science and engineering enterprise. Yet it is well known that diversity within the science and engineering workforce is markedly limited compared to the diversity of the population as a whole. In the geosciences in particular, people of color are underrepresented in graduate degree attainment. Between 1973 and 2003, of the more than 21,000 people receiving Ph.D.s in the geosciences, only 313 were Hispanic Americans, 135 were African Americans, and 49 were Native Americans—accounting for less than 2.5% of all geoscientists receiving doctorates (Madin, 2009).

A regional survey, conducted by COSEE SouthEast (Spence, et al., 2009), was designed to establish benchmarks for future efforts regarding broadening participation in North Carolina, South Carolina and Georgia. The results of the survey showed that diversity in federal and state ocean-science-related agencies and in universities with ocean sciences faculty and staff does not reflect the demographic ethnic/racial diversity of the region. Based on information from supervisors, directors, chairs in charge of staff and faculty, over 92% of agency professionals are considered white and over 87% of faculty/staff are also considered to be white. These results represent a microcosm of what is common throughout the United States in the science and engineering workforce.

Because of the importance—and indeed urgency—of the challenge to significantly increase the diversity of the science and engineering workforce in general, and that of the ocean sciences in particular, COSEE has throughout its decade of existence made this a priority at both the Center and the Network level.

This chapter provides insight into the National COSEE Network (NCN) efforts that have been made and points to the strong potential for greater impacts now that the foundations and strategies have been developed.

Guidance

The ocean education community's foundational document for guidance in addressing the diversity challenge is the Consortium for Ocean Research and Education (CORE) report, "Traditionally Underrepresented Groups in the Ocean Sciences," which provided a challenge to the emerging NCN to devise programs at every educational level specifically designed to increase diversity (CORE, 1996).

Further guidance was provided by the seminal 2008 publication, *Broadening Participation at the National Science Foundation: A Framework for Action* (NSF, 2008). This report provided the rationale for improving science through broader participation and a framework for understanding the challenges involved.

An important source of guidance has come from research in the learning sciences field. Recent National Research Council studies that focused on the science of learning (Bell et al., 2009) highlight the opportunities for educational projects to innovate and study new approaches for broadening participation in STEM disciplines. Three motivations exist for connecting the science of learning to a science of broadening participation in STEM: 1) U.S. society is becoming increasingly diverse (ethnic and racial group representation, global migration, linguistic variation); 2) educational institutions still largely need to learn how to attend to this increasing cultural variation in U.S. society; and, 3) there are fundamental research questions about learning that hinge on dimensions of human diversity and how to build upon that diversity in educational programs as learning assets (Banks et al., 2007).

In the 2000 workshop sponsored by NSF to discuss the rationale, national need, and possible format for an ocean sciences education program, a strong thread was developed for inclusion of traditionally underrepresented and underserved populations in the ocean sciences (McMannus, et al., 2000).

NSF, as part of its Broader Impacts review criterion and workforce development mission, has put a strong emphasis on increasing diversity since 1997, and included specific language to encourage diversity activities in all COSEE solicitations. The 2001, 2004 and 2007 announcements for funding from NSF for COSEE proposals contained the same recommendation that addressed broadening participation: “Ensure that underrepresented groups in the ocean sciences have improved access to ocean science education and research results. Historically, the field of oceanography has not attracted a diverse set of students, and only limited progress has been made in the past decade. Individual Centers should make a concerted effort to include underrepresented groups in educational activities, both formal and informal, involving the oceans.”

With the benefit of guidance from these and other resources, the COSEE Centers across the Network have focused on specific dimensions of equity and diversity in their work, have developed customized programs to broaden participation, and have studied these efforts in order to understand the impact of the developed models.

COSEE Network Efforts

COSEE has sought to increase diversity within the ocean sciences through Network, Council, and Center activities. Diversity is part of the COSEE strategic business plan, the Diversity Working Group is one of several committees of the COSEE Network, and diversity has been a topic in COSEE Council and Network meetings.

COSEE Strategic Business Plan

The COSEE Council addressed our passion to broaden participation through the COSEE Strategic Business Plan (2009) and the resulting Annual Operation Plans. The COSEE Strategic Business Plan establishes the diversity priority throughout the “Values” statements: Collaboration--We recognize the value of diversity and the power of our collective work; Innovation-- We use creative means to broaden participation; and, Vision -- Diverse people of all ages are learning about the ocean and pursuing careers in science.

COSEE's strategic plan contains three major goals; the third goal focuses on underrepresented audiences and states the following: COSEE is using innovative and effective approaches to overcome barriers to access and participation for underrepresented and underserved audiences; the National COSEE Network has diverse representation at all levels (staff, managers, PIs, advisors, and the audiences we serve); and, COSEE has 3-5 quality partnerships at the Network level that focus on underrepresented/underserved groups in the ocean sciences.

Diversity Working Group (DWG)

The DWG was established in 2008, with Deidre Gibson and Dionne Hoskins serving as initial co-chairs; since 2009, Dionne Hoskins and Philip Bell have served as co-chairs.

2009-Present: COSEE Diversity Working Group Membership:

- Philip Bell - COSEE OLC (Co-Chair)
- Dionne Hoskins – COSEE SE (Co-Chair)
- Deidre Gibson - COSEE Coastal Trends
- Ray Barnhart - COSEE Alaska
- Lundie Spence - COSEE SE
- Jessie Kastler - COSEE CGOM
- Angela Bliss - COSEE SE
- Amy Cline - COSEE Ocean Systems
- Lynn Whitley - COSEE West
- Craig Strang - COSEE California
- Lynn Tran - COSEE California
- Carrie Dixon - COSEE CGOM
- Jennifer Niemi - COSEE Great Lakes
- Audrey Kharem - COSEE NOW (Penn State)
- Claudia Benitez-Nelson – University of South Carolina
- Sue Cook – COSEE Florida
- Brandon Jones – COSEE NAC
- Carolyn Randolph-George – COSEE NAC

The DWG is a broker for relevant scholarly expertise. In this capacity, it synthesizes the relevant research literature on best practices related to diversity in science education in general and ocean science education in particular and fosters connections to relevant scholars. It provides the COSEE Network with guidance and support in broadening participation around Center work, around partnership cultivation, and around funding.

In 2009, the DWG compiled an extensive bibliography of resources and articles related to broadening participation in the sciences, *Bibliography to Inform COSEE's Activities Related to Broadening Participation* (Bell, P., Ed., 2009). The full bibliography is available online (<http://bit.ly/hpt7NU>) and includes information in the following categories:

- Relevant Organizations & Web Resources
- Demographic Patterns of Diversity in the Sciences & in Higher Education
- How People Learn in Diverse Communities

- Culturally Responsive Science Education—Effective Approaches to Educational Design
- Programmatic Approaches to Broadening Participation in the Sciences
- Culturally Reliable and Valid Program Evaluation
- Establishing Mutually-Beneficial Partnerships

Using strategies promoted by the DWG, COSEE proactively works to increase diversity in COSEE activities and programs. COSEE connects with other groups, agencies, and organizations that serve diverse groups to bring more diverse audiences into COSEE planning and programs. COSEE establishes strategic connections with academics and other experts who have scholarly expertise in culture, equity, and learning—thereby building capacity to address these issues within the Network. COSEE produces content that is accessible and relevant to a broader set of public audiences. COSEE encourages efforts of COSEE centers to diversify leadership, staff, and team membership.

COSEE Network Conference Actions

Spring 2006 DC: Presentations in the three day Network meeting took place in the afternoon sessions from Brandon Jones of US EPA and Jim Stith of the American Institute of Physics on how their agency and organization addresses proactive efforts.

Spring 2008 Catalina Island: Presentations in the three day Network meeting took place in the morning keynote by Kris Gutiérrez and was followed by a case study panel by Deidre Gibson and Dionne Hoskins on broadening participation in ocean sciences

Fall 2009 DC: Presentations in the two-day Council meeting took places in the morning session by Jacqueline Rousseau of NOAA EPP on success in funding minority serving institutions (MSI's) and mentoring; Jill Karsten of NSF representing OEDG (Opportunities for Enhancing Diversity in Geosciences); and Lisa Rom of NSF representing REU (Research Experiences for Undergraduates). A facilitated conversation about broadening participation across the Network by Philip Bell enabled all Centers to provide their experiences.

Spring 2011 Newport, RI: The Institute for Broadening Participation conducted a half-day training program for NCN members on the practical strategies for increasing diversity in the sciences. Tools included recruitment and retention strategies.

During fall 2009 NSF asked Inverness Research to survey COSEE Centers to learn about efforts aimed at broadening participation as defined by NSF. This survey, “Current Status of COSEE Centers’ Efforts to Broaden Participation,” was designed to generate a picture of the current status of COSEE Centers’ efforts and effectiveness in broadening participation.

Strategic Partnerships

For COSEE to achieve its goal of transforming ocean education, it needs to reach a “tipping point” of recognition and participation — within the scientific community, among under-represented audiences, and geographically on national as well as regional scales.

The effort of the Central Coordinating Office (CCO) has established a presence at the multicultural conference, SACNAS. SACNAS is a society of scientists dedicated to advancing Hispanics/Chicanos and Native Americans in science. It is a national nonprofit organization of individuals and organizations interested in quality science, technology, engineering, and mathematics (STEM) research, teaching, leadership, and policy (<http://sacnas.org/>). COSEE has presented on diversity activities at the Oceans (ASLO/TOS) conferences as well at the Marine Technology Society annual meetings. These organizations have national recognition and are strong advocates for broadening participation.

NSF and Network Survey

During fall 2009 Inverness Research was contracted by NSF to survey COSEE Centers. This survey, “Current Status of COSEE Centers’ Efforts to Broaden Participation,” was designed to generate a picture of the current status of COSEE Centers’ efforts and effectiveness in broadening participation. The online survey was created by Inverness Research in collaboration with members from the Diversity Working Group and the Evaluation Working Group. Centers and the CCO responded to several types of questions and rated, on a scale of 1-5, the strength of their efforts and the effectiveness of their efforts. All Centers and the CCO participated in the survey. A preliminary analysis of the information gleaned from the survey identified three key areas of results.

Efforts to broaden participation of those served by the Center

In terms of efforts to broaden participation of those audiences served by COSEE, in general, programmatic efforts targeting teachers and scientists are strongest. Efforts to form relationships with funders interested in broadening participation are generally not very aggressive across Centers.

Efforts to build capacity in order to broaden participation

COSEE Centers rated themselves highest in the strength of their efforts and effectiveness in building their capacities to broaden participation through the gathering and development of curricular materials and approaches (pedagogies and strategies). They also indicated strong efforts in developing proposals to fund multicultural activities and feel fairly satisfied with where they are in terms of the effectiveness of these efforts. Most of the Centers are making some effort to diversify their working teams or advisory boards. In terms of building Centers’ capacity to broaden participation through networking and partnering, a few indicated they were making a major effort toward building partnerships for serving diverse audiences and a few indicated they were learning from other COSEE Centers that have developed effective approaches for broadening participation.

Overall Center satisfaction with efforts

Their ratings of overall satisfaction with their Center’s efforts are higher than their ratings of effectiveness of particular efforts to broaden participation. This may have to do with their sense that they are satisfied with increasing their efforts, but have not yet seen pay-offs yet. The extent to which COSEE Centers work with other professional networks to broaden participation is rated higher by the Centers than ratings for collaboration across Centers or support network-wide.

Individual Center Efforts

The following section demonstrates a selection of successful COSEE Center programs aimed specifically at broadening participation. Like the Centers themselves, these strategies represent a diversity of approaches and unique strengths, communities and goals; they fall into several categories:

Research and Resource (Curricular) Development

COSEE OLC Learning Sciences Research emphasizes how youth learn about the environment in diverse communities; based on this research, assists institutions to reframe programming to better connect with world views, histories, and interests of these youth and their communities; curriculum design and program partnership with campus GK-12 program and Sound Citizen project.

COSEE Alaska is preparing/promoting publications addressing science education from an Indigenous perspective that will assist in development of effective programs (Aidenhead, 2011; Barnhardt and Kawagley 2010; Barnhardt and Kawagley 2011, Dick, 2010) .

COSEE-OS produces content-rich online tools, e.g., the Ocean Climate Interactive and the Concept Map Builder, designed for all audiences regardless of location, racial, gender, or cultural background with a special emphasis on reaching rural and inland audiences - all available for free. Through a new partnership established with the Institute for Broadening Participation (IBP), OS will explore methods to expand the accessibility and applicability of its online tools and database of scientific content for use by broader audiences.

Customization of Communication Ocean Science (COS)/Communicating Ocean Sciences to Informal Audiences (COSIA) from the University of California Lawrence Hall of Science and COSEE CA events and courses to incorporate relevant local/community culture and native/traditional knowledge

COSEE Alaska hosted a COS workshop at annual Alaska Marine Science Symposium attended by Alaska Natives.

COSEE CA is disseminating COSIA to Hampton University (HBCU), Liberty Science Center, Aquarium of the Pacific/COSEE West and has a collaborative NSF grant with University of Hawaii that focused on new version of COS/COSIA emphasizing traditional knowledge, and traditional ways of teaching and learning.

COSEE-OS developed a 'Teaching Ocean Science through Inquiry' college-level course within two departments at the University of Maine and the University of New Hampshire campuses. One of the resulting products of this endeavor is the publication, "Teaching Physical Concepts in Oceanography: an Inquiry Based Approach" by Lee Karp-Boss, Emmanuel Boss, Herman Weller, James Loftin, and Jennifer Albright, which is available as a free download in English, Spanish, Catalan, and French (http://tos.org/hands-on/teaching_phys.html). This 52-page supplement to Oceanography magazine (Volume 22, Number 3) focuses on educational

approaches to help engage students in learning and offers a collection of hands-on/minds-on activities for teaching physical concepts, e.g., density, pressure, buoyancy, heat and temperature, and gravity waves, which are fundamental in oceanography. However, these concepts and exercises could easily be incorporated into a variety of basic science courses regardless of the geographical location of the students and classroom. To further help teachers with these exercises and demonstrations, videos have also been made available; see <http://cosee.umaine.edu/programs/courses/UMaine491/> .

Development of specific programs or initiatives to broadening participation targeting diverse audience recruitment and engagement in relevant learning about ocean science

NSF OEDG award to COSEE CA initiates ocean science experiences to students, teachers and parents/families at charter urban school in Oakland with pipeline to college emphasis/

NSF OEDG award to COSEE OLC supports apprenticeships for high school youth of color into Sound Citizen project in the laboratory at University of Washington of Professor Rick Keil.

COSEE Great Lakes Inland Seas scholarship program supports two or more Native American groups for learning events on Lake St. Clair.

COSEE Alaska sponsors SEANET designed to bring scientists, educators and community members together to learn about communicating research and traditional knowledge and focus on broader impacts education and outreach.

COSEE CA describes Ocean Literacy Campaign as a significant partner in the development of the international Pacific Marine Educators Network and the NMEA Traditional Knowledge Committee.

COSEE Alaska Ocean Science Fairs in coastal Alaska Native Communities promotes ocean science fairs in schools serving Native students; projects are judged on ocean science quality and cultural relevance by scientists and cultural representative.

COSEE Mid-Atlantic held a multi-cultural workshop for PIs from the COSEE Centers, led by Drs. Shirley Steinburg and Joe Kincheloe . In addition, COSEE –Mid Atlantic recruited teachers from schools with at least 50% underrepresented students for all of its teacher professional development programs.

COSEE SE held a regional, 3-day, multi-cultural charrette (2003) on specific needs and strategies, resulting in an online set of proceedings; initiated a 4-year Diversity Advisory Task Force that met annually to present best strategies; developed a survey to determine benchmarks for regional workforce diversity in state and federal agencies and universities with ocean sciences efforts; and maintain a Board of Advisors with 30% of its membership being non-white.

COSEE SE with a supplementary award from NSF developed a summer shoulder multi-cultural interpretive methods course with Savannah State University (HBCU) that also conducted two 3 day camps for African American children living on Sapelo Island.

COSEE PP works with community college faculty and students. Community colleges provide access to a diverse audience; nationally 53% of Hispanics, 45% of African Americans, 52% of Native Americans and 40% of first generation college students in higher education are enrolled at community colleges. COSEE PP developed the Promoting Research Investigations in the Marine Environment (PRIME) program which provides community college students with a summer internship at marine laboratories in Hawaii, Oregon and Washington. COSEE Pacific Partnerships has held a number of workshops for community college faculty from Hawaii, Micronesia, Oregon and Washington. The workshops connect the faculty with ocean scientists and aim to increase the ocean science content of courses, or assist in developing new offerings in ocean sciences at community colleges.

COSEE PP, through its partner the Shannon Point Marine Center, is working with the Northwest Indian College to provide professional development and student opportunities.

COSEE OS, in close collaboration with the Institute for Broadening Participation and the COSEE OLC, is developing a diversity-focused webinar series starting in May 2011 titled: 'Many Learning Pathways in the Ocean Sciences' highlighting prominent ocean and learning scientists who have made significant contributions to their fields. Utilizing hyperlinked concept maps and online presentation tools, the scientists in the first two webinars of the series will share their stories of scientific advancement as well as successful strategies for mentorship of under-represented minorities (URM) with diverse audiences of new faculty, post-doctoral researchers and graduate students. The project will benefit greatly from IBP's diverse network in the scientific community. The third webinar in the series (scheduled for Summer 2011) will be addressed to formal pre-college and informal science educators and will feature as the science presenters researchers recruited from earlier webinars who will be asked to apply their knowledge of effective communication. For each webinar, an education researcher will follow with literature findings that complement the science presentations (e.g., ways to effectively apply cultural relevance to teaching practices). The final webinar format in the series (scheduled for Fall 2011) will be presented directly to high-school students and include targeted recruitment of teachers with URM students. Each scientist presenter (gleaned ideally from the initial webinar audience of scientists) will serve as a role model, describing his or her life experiences as well as highlighting his or her own research. Thus, a 'nested model of mentorship' (the mentee becomes the next mentor) will be incorporated into this project.

COSEE CGOM personnel have leveraged COSEE CGOM efforts to receive other funds. Since Mississippi has the highest proportion of African American/Black residents in the US, any program will therefore focus on underserved and underrepresented people (UUP) in the ocean sciences under-represented group. The grants include three different NOAA B-WET grants (PIs are Jessie Kastler of USM, Shelia Brown of USM, and Tina Miller-Way of Dauphin Island Sea Lab); as well as one Environmental Protection Agency Environmental Education award (PI Shelia Brown) and two Gulf of Mexico Alliance Mini-Grants (PI Shelia Brown) which placed heavy emphasis on working with UUP.

Focusing work with schools and districts that serve underrepresented student populations

COSEE Central Gulf of Mexico and COSEE SouthEast work with many school districts whose teachers instruct predominantly underserved and underrepresented students. Many students that work with partnering COSEE CGOM ISEs are from districts that serve underserved and underrepresented populations.

COSEE West offers professional development programs within the Los Angeles Unified School District (LAUSD) and other local school districts that serve largely underrepresented school populations. One example is a one-week marine science workshop for a middle school marine science academy at Marina del Ray middle school that serves underrepresented minorities in LA, primarily Hispanic, African Americans, and some Native Americans and Pacific Islanders. COSEE West also partners with a California Math Science Partnership project that focuses on science PD for charter school teachers in inner city schools with high African American and Latino diversity; this project also functions as a research project for identifying successful PD methods.

COSEE New England worked closely with Boston Public Schools and other districts that served high percentages of underrepresented groups, low SES, and low academic performance.

COSEE SE through an NSF OEDG award with South Carolina State University (HBCU) developed a pipeline with the university lab middle school students, undergraduates, and research scientists. COSEE SE selects applicants for workshops with one criteria being those who teach in schools that have predominately students from underrepresented populations in ocean sciences.

COSEE SE with an NSF OEDG award to North Carolina State University has facilitated a 2010 regional workshop with 10 universities and agencies to share effective program information, learn about federal funding programs for diversity and build a community of practice for collaborative.

Partnering with ISE institutions and national organizations that serve underrepresented student populations and study learning environments of diverse communities and settings

COSEE CCO partnership with SACNAS

COSEE Mid-Atlantic partnership with New York Aquarium training teens from underserved communities to present Ocean Observing System (OOS) to general public

COSEE-NOW partnering with Liberty Science Center

COSEE Great Lakes Science Center brings native youth from community organizations for Summer Lake Erie Science Program, supported by COSEE

COSEE OLC collaboration with UW LIFE Center

COSEE SE assists by co-writing or supporting proposals with HBCUs; partners with the SC Association for Black School Educators A (SCABSE) and has assisted with a Gullah-Geechee Island Coalition workshop on coastal planning.

COSEE West partners with EXPO Community Center (LA Parks and Recreation) to offer marine science programs for inner city youth and families from largely underrepresented groups

Providing direct financial support for Center participants, partners, leaders, and teachers to offer or attend events and conferences

COSEE Great Lakes offers funding to non-formal education institutions to offer lake-related science experiences that engage underrepresented students populations who may not otherwise have this experiential opportunity

COSEE SE provides funds/scholarships and mentoring for Black/Latino teachers to present at regional and national conferences

COSEE Pacific Partnerships provides funds to community college students to present results from their summer PRIME internships at regional and national meetings.

Conclusions

The National COSEE Network, consisting of the Centers, CCO, NAC, and people from NOAA and other agencies, has developed a wide variety of approaches to broadening participation. Metrics have been developed by many COSEE activities of the ethnic/racial diversity of the participants and, if educators are involved, the ethnic/racial audiences they serve. In at least one Center, benchmarks have been established for the diversity of the ocean sciences workshop. The National COSEE Network has oriented to the specific dimensions of equity and diversity in its work, has developed customized programs to broaden participation in ocean sciences, and has reflected on the work of other programs as well as its own in order to incorporate a systematic application of this knowledge into future models.

The Centers that are able to focus on Indigenous and Native American populations integrate and multiply their efforts with other efforts within their sphere of influence. Other Centers have broadened participation through unique recruitment strategies, partnerships, and more inclusive leadership. The diversity strategies employed by COSEE have developed capacity and provided insight into how to broaden participation in the geosciences.

The challenge in the next decade is for COSEE to provide a unifying framework that connects the variety of projects into a systemic force. The National COSEE Network must provide a systemic approach, increased sharing of successful projects, widened communication of most effective practices, and strengthened partnerships.

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